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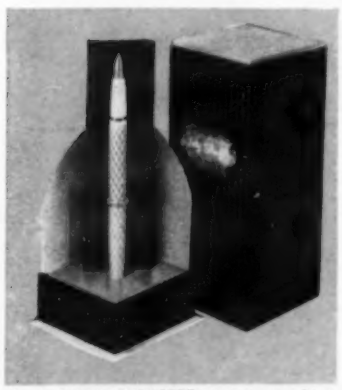

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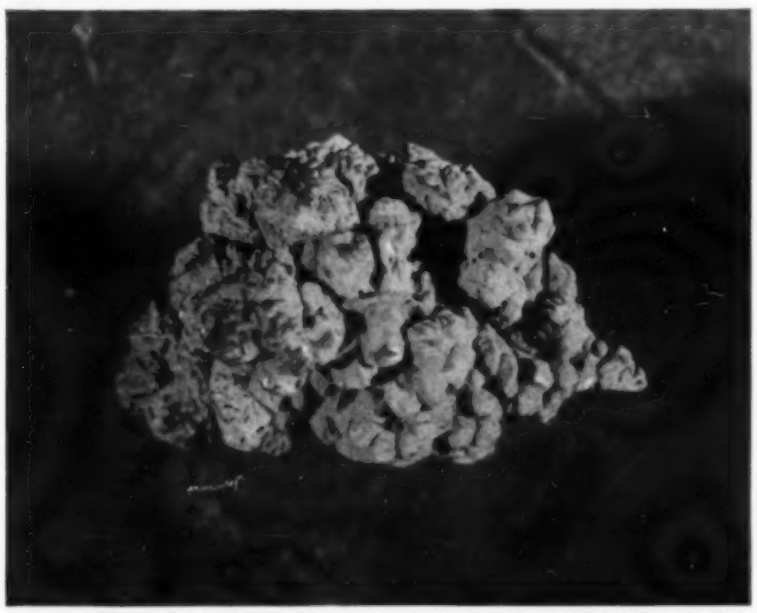
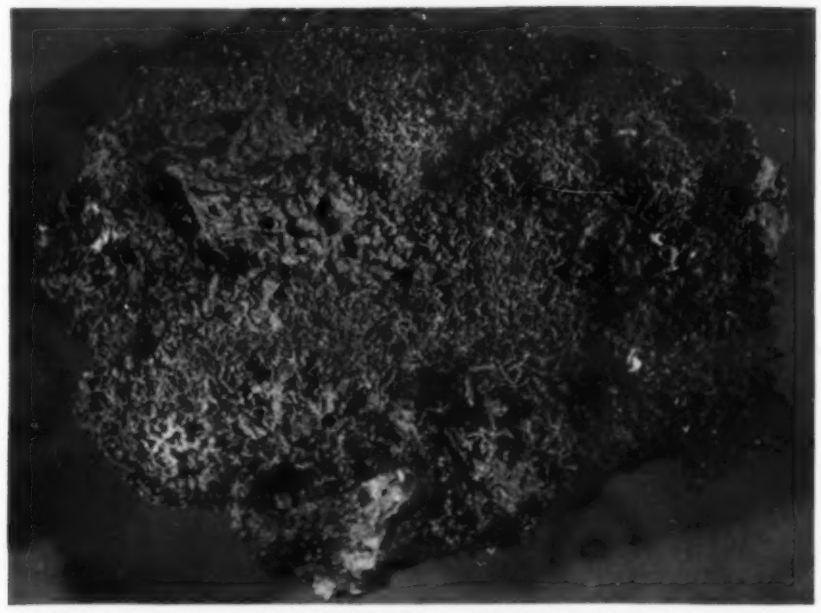
THE ROYAL VISITOR WHO WAS SO POPULAR ON HER TOUR OF HONG KONG, JAPAN, BURMA AND SIAM: H.R.H. PRINCESS ALEXANDRA OF KENT.

Princess Alexandra recently completed the most extensive and demanding of her formal functions, her visit to the Far East which lasted over a month. The increasingly heavy duties now demanded of the Queen, and the marriage last year of Princess Margaret, have naturally thrown a greater burden on the young Princess of Kent; and with her graciousness and charm she has proved herself in a very short time to be an ideal person to undertake visits of this kind. It was a little over a year ago when she triumphantly represented the Queen at Nigeria's independence celebrations. (*Portrait by Archie Parker.*)

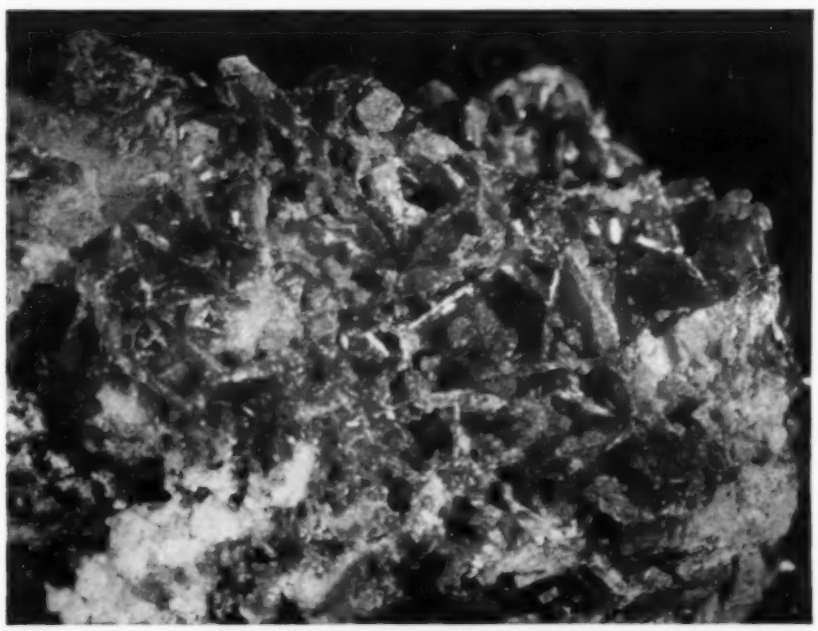
VARIATIONS ON A GROUND BASE OF COPPER, LEAD AND OTHER MET



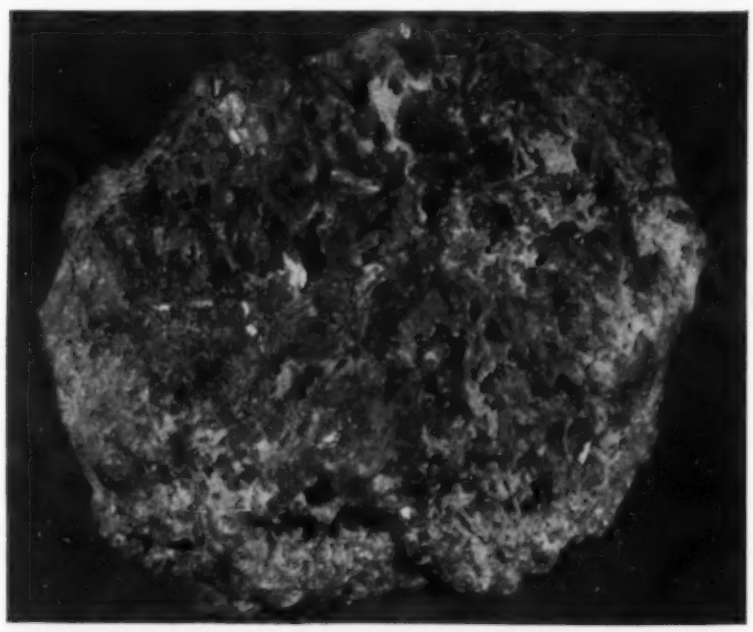
MALACHITE: A BASIC COPPER CARBONATE WHICH IS ONE OF THE MOST COMMON COPPER ORES. WHEN POLISHED IT IS SOMETIMES USED AS AN ORNAMENTAL STONE.



NATIVE COPPER. AS THIS OCCURS IN THE NATURAL STATE NEAR THE SURFACE IT WAS ONE OF THE FIRST METALS TO BE USED BY MAN.

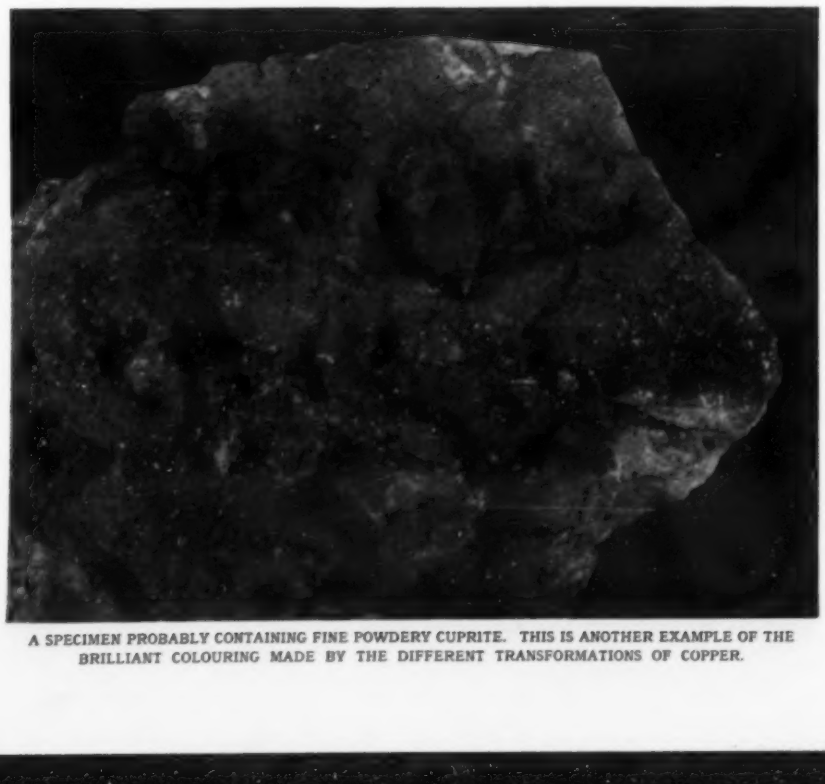


WULFENITE: A RESIN-COLOURED MINERAL WHICH OCCURS IN THE OXIDATION ZONES OF LEAD DEPOSITS. ITS MOLYBDENUM CONTENT MAKES IT COMMERCIALLY VALUABLE.



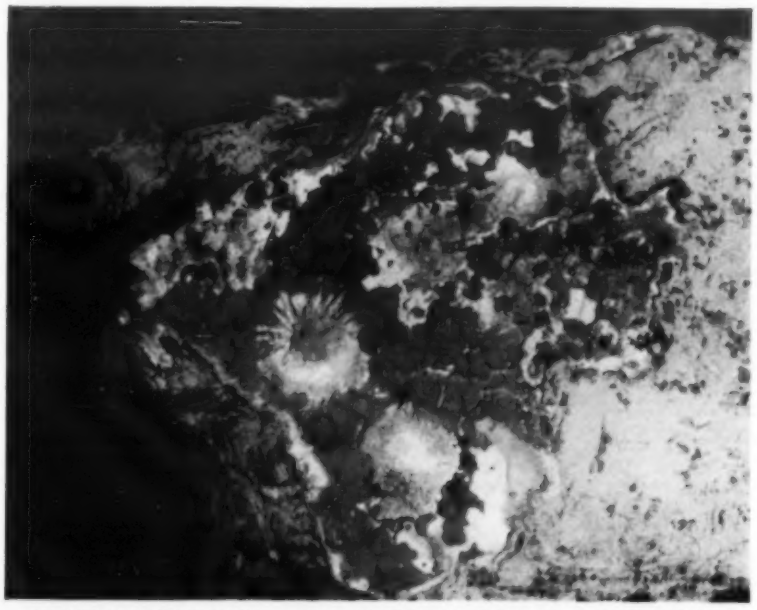
CALEDONITE: A SPECIMEN OF ONE OF THE RARER MINERAL FORMATIONS. ITS NAME REFERS TO SCOTLAND WHERE IT WAS FIRST FOUND.

These brightly-coloured mineral specimens come mostly from Bisbee, Arizona, which is a fertile centre for amateur mineralogists. The greater part of them have formed when a mass of primary copper has been eroded and exposed to the action of the atmosphere. Wulfenite, however, is the result of the same thing happening to lead ore. The strange orange-coloured sponge-like specimen of Native Copper is the most interesting historically of these minerals since it was the first useful metal found readily available to man. Its softness meant that it could easily be shaped into weapons and vessels. Large and valuable nuggets of the metal in this form have been found underground near Lake Superior with evidence to show that pieces of it had been hacked off by Red Indians in earlier times. The largest mass of copper in this state ever found was in Minnesota in 1857; this weighed 420 tons. Later, probably by accident, it was discovered that copper could be smelted. The type of metal produced depended on the exact composition of the mineral used but in some places such as Cyprus from which the word copper derives, pure copper was produced. However, as we can see from its various transformation on this page, copper occurs in nature in many other forms than that of metal; these forms may be sulphide, carbonate, oxide or in combination with other elements. Copper is the metal which forms the largest group of minerals, 360 of which have been given specific names. The copper sulphides are especially unstable when exposed to the action of the weather and thus copper deposits are very open to oxidation and enrichment. The chief primary copper mineral is chalcopyrite, which when near to the action of wind, atmosphere, and rain becomes decomposed by oxidation to form the two brightly-coloured copper carbonates, malachite and azurite, both of which are shown here. Malachite has been extremely popular at various times in history for use in jewellery; azurite's name derives from its brilliant blue colouring. More and sometimes all of the original copper content may be drained downwards as a soluble sulphate, thus leaving near the surface an area from which the copper has disappeared and where the iron, changed to limonite, remains to form gossan or capping. By a process known as secondary enrichment the copper which is carried down below the surface may be deposited in the form of the sulphides, chalcocite and bornite, both of which are much richer in copper than the original chalcopyrite. Bornite can be seen here. The zone where this enrichment takes place is sometimes known as the chalcocite zone; this varies in thickness from a few feet to more than a thousand feet. Below this zone normally comes the primary zone where the copper minerals are generally in their original state. In certain areas, for example, parts of Chile where the wind blows in salt from the sea, the copper may form the mineral atacamite and the basic sulphate brochantite. These two minerals are among the chief sources of copper at the largest copper producing mine in the world, Chuquicamata, in Chile. The chief sources of the metal in the U.S.A. are sometimes called the porphyry ores which are low-grade disseminated copper sulphide ores where the lean primary ores have been enriched by secondary processes in the manner described above. Copper can be found in



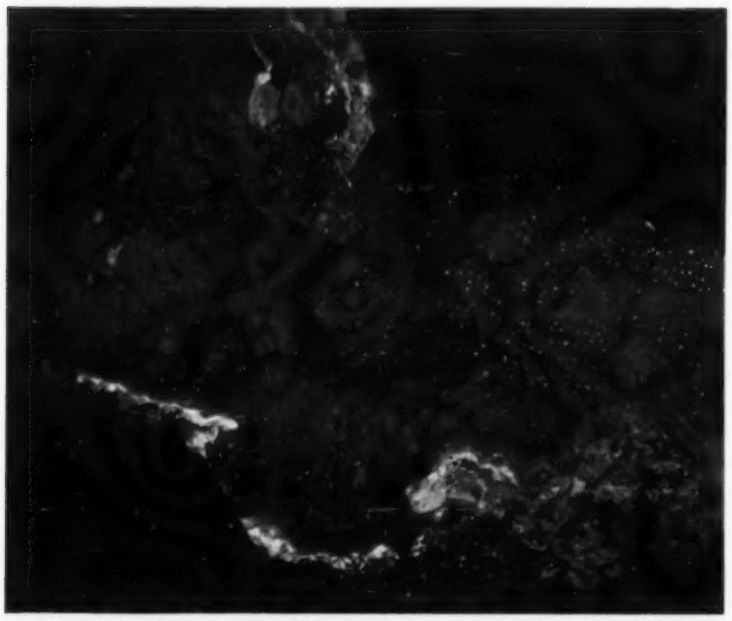
A SPECIMEN PROBABLY CONTAINING FINE POWDERY CUPRITE. THIS IS ANOTHER EXAMPLE OF THE BRILLIANT COLOURING MADE BY THE DIFFERENT TRANSFORMATIONS OF COPPER.

ER METALS: SOME BRILLIANTLY-COLOURED MINERAL SPECIMENS.



ROSASITE AND AURICHALCHITE. THESE PRETTY SKY-BLUE BASIC CARBONATES OF COPPER AND ZINC ARE INDISTINGUISHABLE FROM ONE ANOTHER IN THIS SPECIMEN.

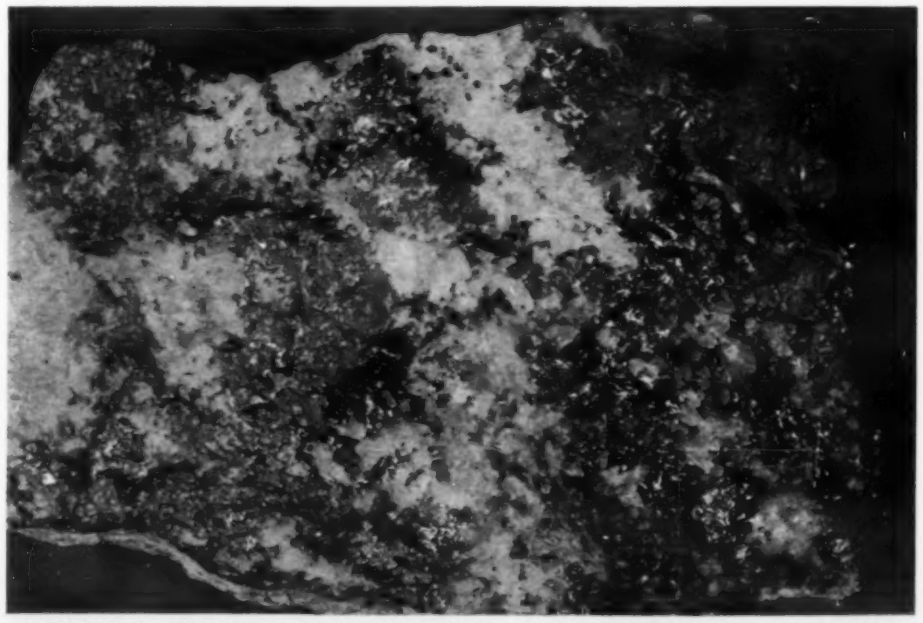
TORBERNITE: A GREEN OXIDISED URANIUM MINERAL WHICH ACCOMPANIES URANINITE. THE BEST EXAMPLES OF TORBERNITE COME FROM CORNWALL.



AZURITE. THIS IS OFTEN FOUND IN CONJUNCTION WITH MALACHITE. ITS NAME, WHICH ALLUDES TO ITS DEEP BLUE COLOURING, IS WELL-DESERVED.

DIOPTASE: AN EXAMPLE OF THE BRILLIANT GREEN COPPER SILICATE DIOPTASE ENCRUSTING WULFENITE WHICH IS ILLUSTRATED ON THE FACING PAGE.

sedimentary, metamorphic and igneous rocks. In disseminated deposits, such as those which have been exploited in the last forty years in Katanga and the adjoining part of Northern Rhodesia, the copper minerals are scattered throughout the rock which has to be mined and drilled on a large scale. It is fascinating to connect in one's imagination these brightly-coloured specimens with the vast world production of copper which is still as much in demand to-day as ever it was in the Bronze Age. Its most important use to-day is in the electrical industries because of its high electrical conductivity. The blue-green colours which copper reproduces can be studied on any church which has its steeple cased in the metal. Copper sulphate or blue vitriol is used in calico printing and certain copper salts are used for colouring glass. Some of the crystals such as those of rosasite and aurichalchite, which are basic carbonates of copper and zinc, need to be looked at under a microscope for their beauties to be revealed fully. The same may be said for another copper product, chalcotrichite, which is not illustrated here but which, as its name implies, is formed of myriad small hairs. These catch the light in a wide range of roseate hues. Of the two specimens, wulfenite and torbenite, shown here which do not belong to the same copper family, torbenite is a green-coloured oxidised uranium mineral which accompanies pitchblende and uraninite, the most important of all the uranium minerals. Pitchblende is so called because of its pitch-like lustre. Other oxidised uranium minerals are autunite which is yellow, curite which is named after Madame Curie, the discoverer of radium, and which is reddish-brown or yellow, gummite and others which occur in dolomite. These are all considered to be related to the copper ores of Katanga. One of the most important uranium deposits of the world is that of Chinkolobwe, in the Congo, near the Kambove copper mine in Katanga; this was discovered in 1913. The other great deposits are in Great Bear Lake, in Canada. The best examples of torbernite come, in fact, from Cornwall. The name torbernite is after the Swedish chemist, Torbern Bergman. Wulfenite is interesting not only because it looks like over-crystallised marmalade, but because it is a minor source of the important product, molybdenum. Molybdenum, which is chiefly used in the manufacture of special steels, does not occur in the metallic state in nature. It has to be obtained from molybdenite which is its chief source, and from wulfenite. Molybdenite is a soft lead-grey mineral like graphite in appearance and generally to be found together with granite and granitic rocks. Wulfenite may be found in the oxidised parts of deposits where the primary ores contain molybdenite and galena. Large amounts of molybdenum are used in making steel for tools which can cut ordinary steel, in aircraft, locomotives and many other purposes. Compounds of molybdenum are used as chemical re-agents.

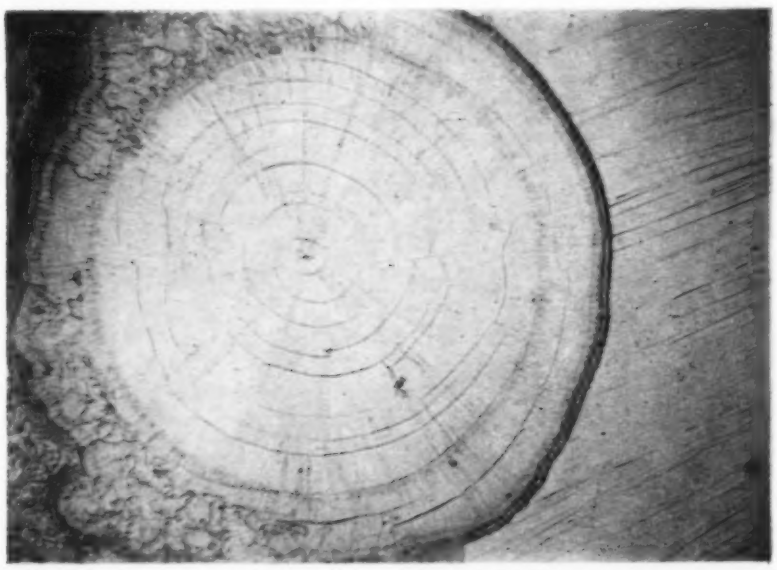


A SPECIMEN CONTAINING BORNITE. THE PURPLE PARTS ON THIS EXAMPLE ARE BORNITE, WHICH IS A COPPER-IRON SULPHIDE FORMED BY A PROCESS KNOWN AS SECONDARY ENRICHMENT.

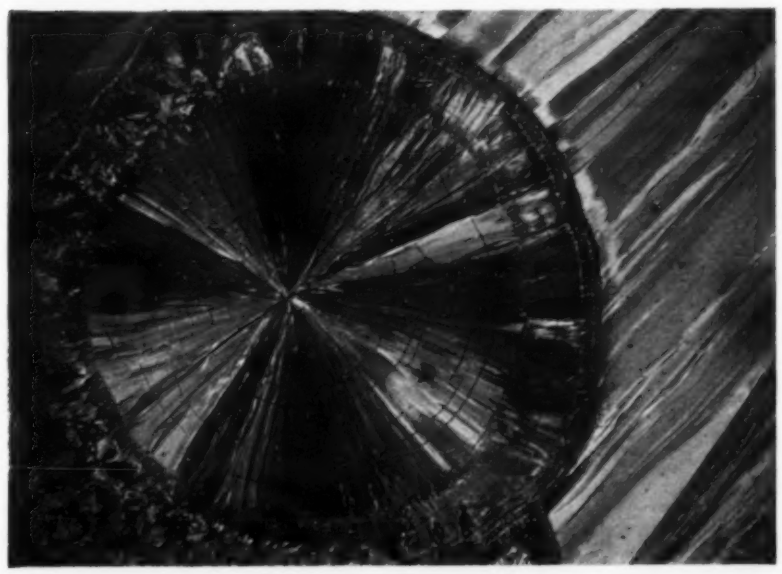
THE FANTASTIC WORLD OF POLARISED LIGHT—IN CRYSTAL PHOTOMICROGRAPHS.

A SUBTLE AND SOMBRE PATTERN: SALICIN CRYSTALS PHOTOGRAPHED THROUGH THE MICROSCOPE BY TRANSMITTED ELECTRIC LIGHT (MAGNIFICATION, x 17) . . .

. . . AND THE SAME FANTASTICALLY DIVERSIFIED BY POLARISED LIGHT, ALSO TRANSMITTED. THE MAGNIFICATION REMAINS THE SAME.

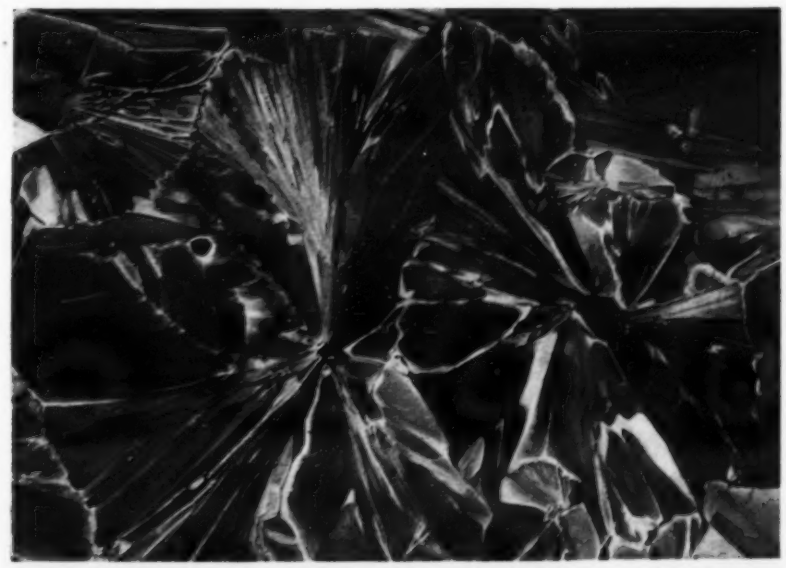


LIKE THE GHOST OF A TREE TRUNK SECTION: ANOTHER PART OF THE SAME SALICIN CRYSTAL FORMATION, SAME MAGNIFICATION . .



. . . TRANSFORMED TO A KALEIDOSCOPE OR LUNA PARK WHEEL BY THE EFFECTS OF POLARISED LIGHT. THE BASIC STRUCTURE, HOWEVER, REMAINS.

IN THIS CASE THE CRYSTALS ARE OF TARTARIC ACID, TRANSMITTED ELECTRIC LIGHT IS USED, BUT THE MAGNIFICATION IS STEPPED UP TO x 26 . . .



. . . AND POLARISED LIGHT TRANSFORMS WHAT IS ALMOST EXACTLY THE SAME VIEW TO WHAT IS APPARENTLY AN ASSEMBLY OF SOUTH AMERICAN BUTTERFLIES.

Just as mystical experience reputedly transforms the whole of life and just as mescalin and lysergic acid—so the experimenters report—intensify ordinary experience into a brilliant and sometimes alarming phantasmagoria so, it would seem, does polarised light behave in the austere calm of the laboratory. What is polarised light? This would take more space to set down than is here available, and it is perhaps sufficient to explain *how* the effect is produced. A piece of Polaroid film is placed in the beam of light before it enters the microscope objective; and another piece of the film is placed inside the eyepiece at the top of the microscope tube. If the eyepiece is then turned slowly it will be found that at a certain point no light will reach the camera. If, then, a slide of certain crystals or thin rock-slice is placed on the stage, the characteristic polarised effect will be seen. This is how the fantastic pictures shown on the right of this page were made—on Kodachrome A film with a 35 mm. single-lens reflex camera mounted on top of the microscope eye-tube via an adaptor. The light source was a low-voltage 30-watt bulb. The exposures for the polarised light pictures were made at 1/5 sec. and those for the same crystals by normal lighting at 1/50 sec., using transmitted light in all cases. The procedure has important technical uses, since materials like chemical crystals, rock-slices, starches, vegetable fibres and animal and vegetable tissues are best studied in this way, inasmuch as the highly-coloured images so obtained have higher contrast and this serves to increase the visibility of very fine detail—a point made abundantly clear by the three pairs of examples shown above.

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